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SCIENCE IN THE DAYS OF THE
INQUISITION.

Giordano Bruno. By J. Lewis McIntyre, M.A., D.Sc.
Pp. xvi+365. (London: Macmillan and Co., Ltd.,
1903.) Price 10s. net.

Galileo: His Life and Work. By J. J. Fahie, M.I.E.E.
Pp. xvi+451; with 27 illustrations. (London: John
Murray, 1903.) Price 16s. net.

IT is a remarkably opportune coincidence that these two volumes, dealing as they do with the lives of two pioneers of science of the Italy of three hundred years ago, should have appeared almost simultaneously. Each book would be interesting in itself, but when taken together the lives of Bruno and Galileo afford us a striking insight into the state of scientific knowledge at the commencement of the seventeenth century, the great advances made by the philosopher and the physicist, each working on independent lines, the opposition which their labours aroused and the manner in which that opposition was affected by the character of the new ideas which they propounded.

Whether we read the life of Bruno or of Galileo we find the same story told regarding the obstacles against which the two workers had to contend. These were (1) the widespread and deeply-rooted belief in Aristotle, (2) the prevailing opposition to the Copernican doctrine, and (3) the hostility of the Church of Rome towards any philosophy or doctrine which could be interpreted as coming into conflict with the teaching of the Bible, even though the exponent himself was at heart a zealous churchman.

The philosopher was necessarily brought into conflict with these influences at every step of his progress; not so the mathematician and physicist, who, so long as he came before the world as an inventor only, was standing on safe ground on which he could gain for himself an immense reputation. Accordingly, we find that while Bruno met with an early martyrdom, and his works sank into an oblivion from which they were not rescued until recently, Galileo's fame never suffered extinction, and the petty persecutions to which he was subjected are believed by the present writer of his life to have stopped short of actual personal torture.

Giordano Bruno was born at Nola, near Naples, in 1548, and at the age of fifteen entered the Dominican monastery at Naples. His advanced views soon brought him into trouble. In 1576 he left Naples, and, after sojourning three years in various parts of Italy, he arrived finally in Geneva, where he appears to have found the Calvinistic spirit of the times but little less narrow-minded and little more tolerant than the Catholicism which he had left behind in Italy. At Paris he met with an enthusiastic reception, gaining the support and admiration of King Henry III. Here he brought out his works "*De Umbris*," "*Ars Memoriae*," "*Cantus Circæus*," "*De Compensiosa Architecturâ*," and his comedy, "*Il Candelaio*"; moreover, he was appointed to a university readership.

Not contented, however, he migrated to England and tried to establish a footing in Oxford, where he found little encouragement from a University in which implicit belief in the teachings of Aristotle was enforced by fines and penalties. His career was cut short by his success in "flooring" his opponent in a controversy. We note among many other interesting points that "what Bruno condemned in Oxford was the undue attention it gave to language and words, to the ability to speak in Ciceronian Latin, and in eloquent phrase, neglecting the realities of which the words were signs." In London the French Ambassador, Mauvissière, gave him a home, and he became acquainted with Sidney, Greville and other distinguished men. "No fewer than seven works from Bruno's facile pen were published in England." His experiences of English life in the Elizabethan times are interesting reading, but the English attitude of indifference to his teachings appears to have been highly irritating to a man of his disposition. At Wittenberg (1586-1588) he lectured to a sympathetic and appreciative university, and published a number of important books; as his biographer remarks, it was the last or nearly last spell of happiness that life had in store for him. At Helmstadt he was less fortunate, being excommunicated by the pastor Boethus. In 1590 he left for Frankfort, where he superintended the printing of his two great works "*De Minimo*" and "*De Immenso*."

Bruno's desire to be received back into his church probably formed one of his motives for accepting an invitation from one Mocenigo, of Venice, which proved to be his death-trap. A few months later he was denounced to the Inquisition, his case came before a tribunal, and he was sent to Rome, where, after a period of incarceration of about seven years, he was burnt as a heretic.

Of Bruno's philosophy we can only touch on a few points. He believed in an infinite deity and an infinity of worlds, his argument in favour of the latter doctrine being based on the perfection of the universe. There is room in the universe for an infinity of worlds, Bruno would contend, and a universe containing them must be more perfect than one without them, therefore we cannot believe in Divine perfection without admitting their existence. Of the "coincidence of contraries," now better understood to mathematicians as the "change of sign in passing through infinity," Bruno gives some illustrations which nowadays appear curious. For example, the coincidence of infinitely quick and infinitely slow motions is deduced from the fact that a body moving infinitely quickly in an orbit is at every instant at every point of the orbit and, "therefore, it stands still" (p. 179). His notion of matter as atomic (p. 241) led Bruno in "*De Minimis*" to formulate a geometry, offered as a simplification of Euclid, of which it is difficult to judge by existing standards. In regard to rectifying the circle through the ultimate coincidence of arc and chord, he agreed fairly well with modern theory, but he did not admit that a figure of one shape could ever be equal to a figure of another shape except approximately. An angle, though it could be multiplied indefinitely, could

only be divided into two equal parts; a circle had not an infinite number of radii, for from the centre only six lines could be drawn; a line could not always be bisected, for it might contain an odd number of atoms, and geometrical bisection was at best an approximation.

In his views on the value of riches, on progress, peace, happiness and such matters there is little to which objection could be raised nowadays. He appears to have believed in the transmigration of souls. In other matters of religion he arrived at views not differing much from those of a thinking man of the present age. He approved of religious worship as appealing to a class of intellect to which a purely philosophical religion would be incomprehensible.

Against the philosophers who, in the words of Socrates, "think they are wise when they are not," Bruno casts many a dash of sarcasm. "Many of the Peripatetics," he says in the *Cena*, "grow angry and flush and quarrel about Aristotle, yet do not understand even the titles of his books" (see p. 122). Does not this represent the position of the average present-day politician in regard to the Fiscal Question?

Bruno's philosophy was so far in advance of the narrow views of his time that he could not fail to make enemies. His endeavour to influence men for the better brought on him a fate which others had shared before him, and his name was quickly forgotten, not to be restored until nearly two centuries later.

The discoveries of Galileo have been brought more conspicuously before the world than the philosophy of Bruno, and their study presents little difficulty to the least advanced student of physics; nevertheless, there is much for everyone to learn from a perusal of this excellent biography. His discovery of the pendulum, whether from observations of the famous "Lampa di Galileo" at Pisa or otherwise, his restatement of the principle of Archimedes, his claims to be regarded as the inventor of the telescope, his discoveries of Jupiter's satellites, and of the appendages of Saturn, recognised as a ring forty-six years later by Huyghens, his observations of the crescent form of Venus, of the mountains of the moon, and of sun-spots, his attempts to solve the problem of longitude at sea by means of Jupiter's satellites, his investigations on floating bodies, and on uniformly accelerated motion, his discovery of the librations of the moon, his geometrical and military compass, all these and many other results of his genius are well and faithfully described.

In regard to the telescope we infer that, although the inverting telescope had been previously arrived at by accident by Dutch opticians, Galileo's erecting telescope with concave eyepiece embodied a different principle, but the biographer might have made this point clearer.

Of the difficulties against which Galileo had to contend much is said. His futile early attempts to obtain a chair of mathematics met at last with success at Pisa when he was only twenty-five, but his salary there was but 13l. per annum. Moreover, his refusal to adopt blindly the doctrines of Aristotle brought him

into conflict with the University authorities, who showed their animosity against him by fining him for loss of lectures and by the countless little persecutions which the dons of unenlightened universities have from the earliest times brought to bear against men of independent reasoning power. The same hostility against Galileo was maintained by Pisa up to the end.

His happiest years were spent as professor at Padua, where students from all parts of the world flocked to hear his lectures and to receive private tuition from him. His classes overflowed the great hall of the university, and he even had to lecture in the open air. His discoveries attracted the admiration and esteem of the great potentates of the age, and his telescopes were eagerly sought for. His very success was indirectly the cause of his later troubles. That there is no rest but the grave for the pilgrim of science is well illustrated by his experience. For though his public duties only occupied him for sixty half-hours in the year (p. 118) his time was so taken up with private pupils that he gladly accepted an offer from his friend and old pupil, Cosimo II., Grand Duke of Tuscany, of a permanent endowment for research under the title of First Mathematician and Philosopher.

So long as he was under the Venetian Republic Galileo breathed in a free atmosphere. A comparison with Bruno's unfortunate experience in no way contradicts this view. Galileo was only appointed at Padua in September, 1592, about two months after the Venetian tribunal had concluded its sittings on Bruno, and it further appears that the State offered considerable resistance to Bruno's extradition, and only yielded to Papal pressure after it had been pointed out that Bruno was not a Venetian subject, and further that he was the subject of charges instituted previously in Naples and Rome. It was not till eighteen years later that Galileo left Padua for Florence, where his real troubles began. The discoveries of his telescope excited the hostility of the Aristotelian faction, and they supported the Copernican doctrine to such an extent as to bring him under the ban of the Romish Church. He was denounced to the Inquisition in 1612, but it was not until 1633 that proceedings were taken which resulted in the philosopher of seventy years being bound by oath to abjure the Copernican doctrine and being treated as a prisoner for the last nine years of his life. During that time, in his exile at Siena and Arcetri, his interest in science never waned, despite his infirmities, and he devoted his attention to dynamical problems on which he was still at liberty to express opinions. That Galileo discovered the principle of virtual velocities is a fact that may come as news to some of us.

In all the proceedings against Galileo his old *Alma mater* and enemy, Pisa, figures prominently. Of the obstinate spirit of the Aristotelians we have instances in Galileo's early experiments in dropping falling bodies from the Leaning Tower.

"With the sound of the simultaneously fallen weights ringing in their ears they still persisted that the 10lb. weight would reach the ground in $\frac{1}{10}$ of the time taken

by one of 1lb., because they were able to quote chapter and verse in which Aristotle assured them that such is the fact."

Others later on positively refused to look through his telescopes or to test his experiments on floating bodies.

The connection between music and mathematics was maintained in Galileo's case. He played on the lute and his father was a well-known authority on music.

Of the books themselves we can speak in the highest terms. Dr. McIntyre has evidently made an exhaustive study of recent editions of Bruno's works. His is the only English work dealing completely with Bruno's life and philosophy, and it is illustrated by a frontispiece of the statue erected in 1889 on the site on which Bruno was burnt. Mr. Fahie has been fortunate to secure the assistance of Prof. Antonio Favaro, himself the author of a monumental collection of Galileo's works. Every minute point, such as the familiar "Eppur si muove" anecdote is examined critically and the book is beautifully illustrated.

Let us not close these volumes without comparing the positions of scientific workers three hundred years ago and at the present time. The comparison brings little credit to our nation. Science teachers have quite recently been deprived of their posts, and their careers have been ruined by inquisitions. The attitude of the peripatetics towards experimental science finds its counterpart in the attitude of the modern "practical man" towards all pure science above B.Sc. standard. As for the hostility of Pisa towards Galileo, it has been pointed out elsewhere that workers at the two older English Universities have, in several cases, had to contend against similar and equally persistent opposition on the part of their *Alma mater* quite recently. It is true that men are no longer imprisoned, tortured, or burnt on account of their convictions. But, on the other hand, philosophers and mathematicians to grand dukes have ceased to exist.

G. H. BRYAN.

A MONOGRAPH ON IMPORTED PARROTS.

Parrakeets. A Handbook to the Imported Species.

By David Seth-Smith, M.B.O.U., F.Z.S. Pp. xix + 281; with 20 coloured plates and other illustrations. (London: R. H. Porter, 1903.) Price 40s. net.

MR. SETH-SMITH'S valuable monograph of the imported species of parrakeets is now complete, and forms a handsome, well-proportioned volume. Scientifically speaking, there is no distinction between a "parrot" and a "parrakeet," the latter word being merely a popular term used for the smaller parrots. It cannot be applied to any particular family, or to those species with long or short tails. The title of this work must therefore be interpreted in the sense in which it is generally used by aviculturists. The work treats of about 130 species belonging to the families Loriidæ, Cacatuidæ, and Psittacidæ (subfamilies Nasiterninæ, Conurinæ, Palæornithinæ, and Platycercinæ). No less than thirty-three species are represented on the beautifully executed coloured plates, and there are more than a score of illustrations in the text, chiefly illustrating the nesting and other habits.

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Moreover, the author has been careful to indicate the work or works in which a coloured illustration of those species not figured by him may be found. Full and most useful directions as to feeding and managing the different species are given, as well as for breeding those species which have reared, or are likely to rear, their young with us. It is also pointed out which species are most suitable for large aviaries, and which are more adapted for smaller cages. The whole book throughout is most readable and instructive. For as well as all worth reproduction which has been written about the different species in captivity, the author has collected from the folios of Gould, Mr. A. J. Campbell's "Nests and Eggs of Australian Birds," Dr. Mivart's "Monograph of the Loriidæ," and many other works a great deal that has been written about the life-history and habits of the birds in a wild state, so that his work forms an excellent history of these beautiful birds, and is alike interesting to the field naturalist and the aviculturist.

Turning over these interesting pages we notice especially the lorikeets or brush-tongued parrots, some of the most gorgeous of the tribe; the familiar cockatiel, which, with the exception of the budgerigar, is the commonest Australian species with English bird-keepers, breeding regularly in captivity; and the numerous race of the American conures. This group contains two species of especial interest, viz. the Carolina conure and the grey-breasted parrakeet. The former is the only North American parrot, and although once so abundant, seems likely to share the fate of the passenger pigeon. The latter, belonging to a genus containing but two known species, is one of the most interesting in the whole parrot family from the fact that these are the only nest-building parrots known, with the exception of the love-birds (Agapornis), which line their nest-hole with the pliant pieces of bark from green twigs, and may therefore be termed nest-building parrots. The present species, however, builds a large nest of sticks among the branches of tall trees, which no other parrots, so far as is known, ever do. It is gregarious, always living in flocks, and the nests, which perhaps at first are single and inhabited by a single pair of birds, are gradually added to until they become of enormous size. There is a porch to each chamber, and the present writer has often seen the black beady eyes of these little parrots peeping out as he passed under trees bearing these wonderful nests.

Then we come to the large genus *Palæornis*, to which belong parrots that have been known to civilisation from a remote period, e.g. the blossom-headed parrakeet, believed to have been described in the fifth century B.C. The restricted genus *Polytelis* includes the beautiful parrakeet known to Australians as the "green leek." The love-birds are remarkable, as before mentioned, for their nest-building habits, and those gorgeous little birds, the hanging parrakeets, for their curious habit of suspending themselves head downwards when sleeping. Among those species the beauty of which singles them out among a beautiful host, we have the broad-tailed parrakeets, of which the Rosella is the best known; the rarely imported